The Developing Economies, XXXV-4 (December 1997): 358–81

INDUSTRIALIZATION POLICIES OF KOREA AND TAIWAN AND THEIR EFFECTS ON MANUFACTURING PRODUCTIVITY

SATORU OKUDA

INTRODUCTION

THE Republic of Korea and Taiwan are often considered to be similar based on their high growth performance and current income levels. However, their growth structure may not be the same. In order to detect the difference in their growth structure, the author examined the total factor productivity (TFP).

TFP is a part of the value-added growth not explained by the increase in factor inputs, and is considered to be a better indicator of welfare improvement. Specifically, TFP reflects various factors affecting productivity, such as deregulation, improvement in management and production technology, and externalities derived from infrastructure. TFP is also affected by industrialization and related policy measures, such as export experience, inflow of foreign direct investments (FDI), capital intensification, and opening up of the domestic market. As the rise in productivity is a key element for sustained growth of an economy, the analysis of the TFP growth structure for Korea and Taiwan should enable to determine why the industrialization policies implemented in these two economies served to maintain a high economic growth.

In the following, the author focused on the manufacturing industries of Korea and Taiwan, taking into account the availability of data. In the first section the industrialization policies of Korea and Taiwan were summarized, and in the second section the TFP of the two economies was computed and compared at the subsector level. In the third section the relationship between the industrialization policies and TFP growth of the two economies was analyzed using an econometric model which revealed structural differences in TFP growth. In the last section a conclusion was presented.

I. THE INDUSTRIALIZATION POLICIES OF KOREA AND TAIWAN, AND CHANGES

A. *Industrialization Policies in Korea*

The Korean War which broke out in 1950 almost completely destroyed Korea's industrial facilities. After the cease-fire, the Korean government adopted an import-substitution policy. The main emphasis was placed on the promotion of the so-called "three whites" (sugar refinery, milling, and spinning industries). These were typical import-substitution industries, which processed the U.S. aid materials to meet the domestic demand. Other import-substitution industries, such as glass, cement, and fertilizers, also started to operate, but the small domestic market became rapidly saturated with these products. By the late 1950s, the import-substitution policy faced a deadlock.

Under such stagnant economic conditions, Major General Park Chung-hee, who established a military administration in 1961, launched the First Five-Year Economic Development Plan. The plan clearly indicated the government's departure from the import-substitution policy. In 1964, in light of decreasing U.S. aid, the government modified the plan to totally abandon the import-substitution policy. The modified plan advocated industrialization and export promotion in order to obtain the foreign exchange necessary for economic development. Since then, until the so-called "three lows" (the depreciation of the won against the yen, low oil prices, and low international loan rates) period in the late 1980s, the Korean government basically adopted export promotion as a main pillar of the economic policy. In the early stage of export promotion, the government selected light industries as main beneficiaries of the policy, considering that the economy had a well-educated and abundant labor force.[1] However, in 1973, Park implemented a series of heavy and chemical industry policies under his *yu-shin* (revolution) regime which aimed at self-sufficiency of the national economy.[2] Consequently, the government carried out a series of policies aimed at promoting heavy and chemical industries: steel, petrochemicals, shipbuilding, machinery, nonferrous metal, electronics, etc. As for exports, the government's strategy was not only to increase the total foreign exchange income, but also to improve retained foreign exchange, which is defined as export income net of imported inputs. For this purpose, the government encouraged the entrepreneurs to substitute imported capital and inter-

[1] The Korean government's positive attitude toward export promotion can also be perceived in the 1970 amendment of the Foreign Fund Inducement Act. The amendment stipulated that in the process of the government's screening of foreign direct investment applications, it should offer preferential treatment to the export enterprises.

[2] For further details on Korea's policy shift toward heavy and chemical industry, refer to Ishizaki (1996).

mediary goods with domestic ones. The target of substitution progressed gradually in line with the improvement of the export structure. However, the government permitted to import the capital and intermediary goods for which domestic substitution was not easy, provided they were used for producing export goods.

The year 1980 was a watershed in the history of the postwar Korean economy. The economic growth in that year became negative, affected by the second oil shock in 1979, poor harvest of rice, and political turbulence in 1980. In the late 1970s, many firms in heavy industries rapidly expanded their capital equipment which became a heavy burden in the adjustment period of the early 1980s. Also, terms of trade deteriorated drastically, leading to a sharp increase in foreign debt. For several years until the advent of the "three lows" boom, foreign debt management bound the government's economic policy. In the industrialization policy, "expansionism" was abandoned and the government actively promoted the adjustment of investments by the private sector so that the economy would stop holding inefficient capital stock. On the other hand, the government continuously promoted exports, for the foreign exchange income could help lessen the burden of the foreign debt repayment.

The "three lows" after the Plaza Accord in autumn 1985 was an unexpected bonanza for the Korean economy which struggled painfully with the burden of the foreign debt management. Especially, the competitiveness of Korean exports improved greatly vis-à-vis Japan, and Korea entered the unprecedented era of current account surplus. However, the Korean exports, often referred to as "flood," caused trade frictions in various overseas markets, including the United States and European countries.[3] In the domestic economy, on the other hand, the nationwide labor disputes, which broke out in 1987, ignited the two-digit wage hike. As a result, the competition with other developing countries such as China stiffened. Labor-intensive industries, especially spinning, textile, and shoes, lost in the competition, and some firms in these areas started to shift the production sites to other developing countries such as Indonesia and Thailand. In this phase, Korea was compelled to abandon its export-promotion policy which had continued for about three decades. With the reduction in the gap between official and curb loan rates, the gain from export finance became marginal in the 1980s. The won in general appreciated, though occasional fluctuations brought about changes in actual rates. Liberalization of imports was eventually implemented for consumer goods. Facing a strong pressure from the United States, Korea has already opened up its market in the field of what used to be "sensitive items," such as beef and rice.

In the process of Korea's industrialization, the government was not keen on inducing FDI. According to the Ministry of Finance and Korea Development Bank (1993), at the end of 1992, out of U.S.$80.2 billion of foreign fund inflow, FDI

[3] For Korea's trade frictions with Japan and the United States in the 1980s, refer to Ohyane (1992).

accounted for only 9.7 per cent (U.S.$7.8 billion). Nevertheless, the government promoted investments in the strategic industries, offering tax incentives. These preferred industries consisted of export industries until the mid-1980s, and thereafter of those with a potential for technology transfer. In January 1994, the government established the Planning Team for FDI Inducement, in order to introduce more hi-tech industries.

B. *Industrialization in Taiwan*

Since the liberation from the Japanese occupation in 1945, the Taiwan government enforced an import-substitution policy.[4] However, for some industries the domestic market became saturated with the products leading to a surplus for exports. As early as the late 1950s, the Taiwan government decided to follow an export-oriented policy (see Hong 1987, p. 2). In 1957, the Bank of Taiwan started to supply low-cost export credit and in 1958 the government implemented the Foreign Exchange and Trade Reform Plan. In 1960, the government announced three major reforms. Firstly, Statute for the Encouragement of Investment was promulgated in order to introduce FDI as well as to encourage domestic investment. Secondly, multiple exchange rates were unified. Thirdly, the government amended the tariff rebate system introduced in 1955 to further promote exports. During the mid-1960s, export promotion was further expanded with the implementation of additional export-promotion measures, including bonded factories and export processing zones, which started to operate in 1966 and 1967. By this time, it became apparent that the main focus of Taiwan's trade policy had shifted from import substitution to export promotion. Supported by the series of promotion policies, light industry exports, such as textiles, plastics, plywood, and electronics, markedly increased in the 1960s, leaving behind the agro-related commodities such as sugar and pineapple products which had been the staple exports in the 1950s. It should be noted that in Taiwan the government policy in relation to export promotion generally followed the private sector's involvement in exports. This was not the case in Korea, where the government usually preceded the private sector in the export promotion.

In the 1970s, Taiwan's export-promotion policy entered a new phase. The major economic goals during this period were as follows: expansion of infrastructure, self-sufficiency in industrial inputs, and heavy industrialization. To augment the domestic supply of industrial inputs, the government established public-owned enterprises for steel, shipbuilding, and petrochemical industries. This policy is sometimes referred to as the "second import substitution." In 1970, in the amendment of the Statute for the Encouragement of Investment, the government presented a modified investment policy that curtailed support for labor-intensive in-

[4] The chronology presented here relied greatly on Siew (1992) and Satō (1994).

vestment and instead promoted investment for export-oriented firms. In 1973, the government announced the Ten Major Public Sector Projects, aimed at developing infrastructures and some key industries. However, in the 1970s, trade frictions with a number of advanced economies were no longer negligible, and increasing competition with other developing countries intensified.

During the 1980s, Taiwan faced a harsh international trade environment, which hindered rapid growth based on exports of labor-intensive goods. Under such circumstances, the government had to address the problem of trade frictions. To lessen the foreign pressure, the government decided to abandon various export-promotion schemes, along with the intensification of trade and financial liberalization. In the area of domestic industrial policy, the government started to promote capital- and technology-intensive industries due to the dismal achievements of the public enterprises established in the 1970s, and to cope with Taiwan's changing comparative advantage.

Export promotion continued during the 1980s, but the extent of the government support gradually decreased. As for liberalization, tariff reduction and the relaxation/abolition of nontariff barriers proceeded rapidly in the 1980s. It is worth noting that the tariff reform in the 1980s involved a wide coverage of consumer goods which had been heavily protected until the 1970s. In the area of technology development, the establishment of the Hsinchu Scientific Industrial Park was a remarkable achievement. Also, in the Eighth Four-Year Development Plan released in 1982, the government designated four capital- and technology-intensive industries (electronics, general machinery, transport equipment, and precision instruments) as "strategic industries."

Finally, in the FDI policy, the government maintained a generous attitude compared with Korea. In February 1988, the negative list for FDI was reduced further to include only pollution-causing industries, banking and insurance, and public administration. In April 1989, the government lifted the ban on FDI into the banking business. As of September 1994, the total FDI into Taiwan amounted to U.S.$9.5 billion. In contrast to Korea, Taiwan generally did not rely upon foreign loans, as the government did not borrow much from foreign entities, and other foreign loans were not introduced as extensively as in the case of Korea.

II. TFP GROWTH RATES OF MANUFACTURING INDUSTRIES IN KOREA AND TAIWAN

A. *Methodology of TFP Estimation*

The TFP indices used in this paper are based on the growth accounting method[5]

[5] For details on the growth accounting method, refer to Kendrick (1961) and Denison (1962). Kwon

and presented by subsectors. Equation (1) in the following was used for the calculation of the TFP indices. In many of the related studies introduced in Section III the TFP was calculated in a similar manner.

$$\ln \frac{TFP_t}{TFP_{t-1}} = \ln \frac{Y_t}{Y_{t-1}} - \sum_i S_{it} \cdot \ln \frac{X_{it}}{X_{i,t-1}}, \tag{1}$$

where t is time, Y is real value-added growth (GDP), S_i is the distribution share for factor i, and X_i is the input of factor i. The above formula shows that the growth of the real value-added is divided into two portions: a portion due to the TFP growth and a portion due to the input growth (share weighted). Considering related studies carried out previously, the author calculated the TFP indices of Korea and Taiwan manufacturing industries using the data presented in the following studies. Factors were confined to labor and capital only. For Korea, labor and capital figures were taken from Hong and Kim (1996) and value-added figures from Pyo et al. (1993). For Taiwan, ROC, DGBAS (1994) supplied TFP, labor, and capital stock figures.[6] The sample period extended from 1970 to 1993 for Korea, and 1978 to 1992 for Taiwan. Table I displays the TFP growth rates and their contribution to the value-added growth by subsector and by sub-period, for both economies. For Korea, the whole sample period was divided into three sub-periods: 1970–78, 1978–85, and 1985–93. For Taiwan, the sample period was divided into two sub-periods: 1978–85 and 1985–92.[7]

(1986) devised a more relevant TFP index in which economy of scale and capital utilization rate were controlled. Considering the limitation of data, the author adopted the TFP indices using the growth accounting method. However, in order to analyze the effect of scale and capital utilization on TFP, these two variables were added in the regression equation presented in Section III.

[6] ROC, DGBAS (1994) was an important source of consistent data on TFP for Taiwan. The labor figures did not include quality factors such as education. The capital figures corresponded to the gross capital stock. Distribution share of labor was based on the "compensation on employment population," the sum of employee's income as shown in the national account and other kinds of compensations such as officer's compensation, self-employment income, etc. Following Okuda (1994), the author aggregated eighteen subsector data series in ROC, DGBAS (1994) into eleven series. For Korea the author recalculated the TFP index using the data in Hong and Kim (1996) and Pyo et al. (1993). Hong and Kim (1996) was the most recent study available to the author. It supplied the labor and capital figures, as well as distribution shares to factors. Pyo et al. (1993) supplied value-added figures by subsector. Detailed industry classification in Hong and Kim (1996) and Pyo et al. (1993) was aggregated into eleven subsectors. For the sector classifications, see Appendix Tables I and II.

[7] For Korea, the sub-periods generally coincided with the period of heavy and chemical industry promotion, the adjustment period after the second oil shock, and the "three lows" period. For Taiwan, the sub-periods were compared to the transition period toward technology-intensive production and the "three lows" period.

TABLE I

TFP GROWTH AND ITS CONTRIBUTION TO GDP: SUBSECTOR LEVEL

A. Korea

	Food	Fiber & Clothes	Paper & Wood Products	Chemicals	Oil Refinery	Nonmetals	Metals	Machinery	Electronics	Transport Equipment	Other Manuf.	Manuf.
TFP growth (per annum, %):												
1970–78	5.0	5.4	2.8	0.2	1.1	2.7	12.8	10.0	6.3	6.4	0.3	2.6
1978–85	–0.2	–0.2	5.2	–1.5	–6.5	–1.6	8.2	5.9	–0.6	2.8	5.3	1.3
1985–93	4.6	3.5	5.3	5.7	4.8	3.4	4.3	6.8	5.2	8.5	–2.7	5.5
1970–93	3.3	3.0	4.4	1.5	0.0	1.6	8.4	7.6	3.8	6.0	0.7	3.2
GDP growth (per annum, %):												
1970–78	15.0	22.0	13.3	14.7	13.3	15.7	39.2	35.8	38.1	26.0	16.5	18.9
1978–85	8.3	5.4	9.3	8.0	2.2	9.7	17.0	19.1	11.7	13.9	13.0	9.4
1985–93	11.2	7.1	11.7	14.3	14.3	11.6	13.4	19.4	16.9	19.5	0.4	13.5
1970–93	11.6	11.5	11.6	12.5	10.1	12.4	23.0	24.8	22.2	20.0	9.6	14.1
TFP's contribution (%):												
1970–78	33.3	24.5	20.7	1.2	8.6	17.1	32.7	27.9	16.5	24.7	1.7	13.9
1978–85	–1.8	–3.0	55.4	–18.6	–300.8	–16.4	48.2	31.1	–4.9	20.4	40.7	13.6
1985–93	41.5	49.3	45.2	39.5	33.9	29.3	32.2	34.8	31.0	43.7	–769.0	40.7
1970–93	28.3	26.2	37.9	12.3	0.0	13.0	36.6	30.7	17.1	30.2	7.5	22.7

Source: Author's calculation using data on capital, labor, and share on factor in Hong and Kim (1996) and on GDP in Pyo et al. (1993).

B. Taiwan

	Food	Fiber	Clothes	Leather	Wood Products	Paper	Chemi-cals	Non-Metals	Metals	Machinery	Electro-nics	Manuf.
TFP growth (per annum, %):												
1978–85	2.9	3.8	4.3	3.6	1.1	0.2	1.6	1.0	0.7	2.0	4.1	2.5
1985–92	2.0	3.9	–0.8	–0.2	1.1	1.0	0.0	1.6	2.3	4.2	5.7	2.6
1978–92	2.5	3.8	1.8	1.7	1.1	0.6	0.8	1.3	1.5	3.1	4.9	2.6
GDP growth (per annum, %):												
1978–85	7.4	5.8	11.6	13.4	2.4	6.8	8.9	7.1	10.7	7.0	11.8	8.9
1985–92	6.0	3.3	–2.1	–3.3	–0.3	7.5	5.9	4.8	8.6	8.9	12.2	6.5
1978–92	6.7	4.5	4.5	4.7	1.0	7.2	7.4	5.9	9.6	8.0	12.0	7.7
TFP's contribution (%):												
1978–85	39.6	64.6	37.5	26.9	43.9	2.3	17.8	13.5	6.8	28.1	34.4	28.3
1985–92	33.7	119.1	36.5	6.3	–305.3	13.7	1.5	33.9	26.1	46.8	47.0	40.2
1978–92	37.0	84.3	38.8	35.6	104.0	8.3	11.3	21.7	15.4	38.4	40.7	33.4

Source: Author's calculation using data in ROC, DGBAS (1994).

B. *The TFP Indices of Manufacturing Industries in Korea and Taiwan: Estimation Results*

First, let us examine the results for Korea. The manufacturing TFP as a whole grew by 3.2 per cent per annum for the entire period of 1970–93. It is obvious that the growth rate fluctuated depending on the sub-periods. In the adjustment period of 1978–85, the TFP growth decreased to 1.3 per cent per annum, half the figure of the heavy and chemical industrialization period of 1970–78. The TFP growth rebounded in the "three lows" period after 1985, to 5.5 per cent per annum. The contribution of TFP to the value-added growth, which measures the efficiency of factor input, also fluctuated throughout the sample period. After 1985, TFP's contribution was as high as 40.7 per cent, compared to the lower performance of about 14 per cent in the previous periods. Main factor for the higher contribution was the relatively sluggish factor input growth in the later period. The growth of the real value-added for the whole manufacturing sector increased from 9.4 per cent per annum in 1978–85 to 13.5 per cent per annum for the period 1985–93. On the other hand, the growth of the combined factor input (share-weighted input growth of labor and capital) rather decreased from 8.1 per cent to 7.6 per cent, respectively. That is to say, the Korean manufacturing sector registered a higher growth with less input after the "three lows" period.

By subsector, in the case of food, fiber and clothes, paper and wood products, metals, machinery, and transport equipment, the more-than-average TFP contributed to the value-added growth for the whole sample period. Among these subsectors, the value-added growth of metals, machinery, and transport equipment also exceeded the average. They can be aptly referred to as leading sectors, with their technology-intensive characteristics and strong comparative advantage (see Table II). On the other hand, the value-added growth of food, fiber and clothes, and paper and wood products was lower than the average. These industries are characterized by import competition with less developing countries. In the case of the subsectors of chemicals, oil refinery, nonmetals, and other manufactured products, the TFP contribution as well as the value-added growth was lower. Most of these sectors intensively utilized natural resources.

In the case of Taiwan, for the whole sample period of 1978–92, the TFP growth of the manufacturing sector was 2.6 per cent per annum. By sub-period, a marginally higher figure was registered in the later sub-period of 1985–92. TFP growth itself was slower than in Korea, but it contributed more to the total value-added growth for the whole sample period. The contribution was 33.4 per cent for the whole sample period of 1978–92, and especially in the "three lows" period of 1985–92, the contribution rose to 40.2 per cent. By subsector, food, fiber, clothes, leather, wood products, machinery, and electronics registered more-than-average TFP contribution. Among these, only machinery and electronics recorded a higher

TABLE II

COMPARATIVE ADVANTAGE OF SELECTED INDUSTRIES IN KOREA AND TAIWAN
(Revealed Comparative Advantage Index, 1990)

	Korea	Taiwan	(Japan)
Processed food	0.43	0.37	0.12
Textile	3.00	2.92	0.66
Clothes	3.85	1.86	0.06
Leather / shoes	6.01	4.83	0.10
Wood products	0.34	2.39	0.12
Chemicals	0.41	0.39	0.65
Oil products	0.40	0.00	0.02
Iron / steel	1.69	0.40	1.33
Metals	1.45	2.73	0.84
Electronics	2.23	1.74	2.22
Automobiles	0.37	0.17	2.49
Other transport equipment	2.06	0.92	0.77
Precision equipment	0.51	0.90	2.61

Source: Author's calculation using the trade data retrieval system (AIDXT) of the Institute of Developing Economies.

Notes: 1. Industry classification does not necessarily correspond to that for TFP analysis.

2. $RCA_{xih} = (X_{ih} / X_i) / (W_h / W)$. RCA_{xih} = revealed comparative advantage index of country i in commodity h, X_{ih} = exports of commodity h from country i to the rest of the world, X_i = country i's total exports, W_h = the world total of commodity h trade, and W = the world trade volume. For instance, RCA_{xih} above unity implies that country i has a comparative advantage in commodity h. Note that RCA_{xih} indices are defined for country i's exports and measure the competitiveness of country i's exports.

value-added growth than average, and for the remainder the value-added growth became rather stagnant. The outstanding performance of the electronics industry was due to its technology-intensive characteristics and comparative advantage (see Table II). The other industries listed above were import competitive with other less developed countries. In the subsectors of paper, chemicals, nonmetals, and metals, TFP contributed only less than average, and these industries are generally considered to be resource intensive.

C. *Comparison of Estimated Results*

A comparison of the estimated results reveals that in Korea and Taiwan the TFP growth tended to increase in the "three lows" period of 1986 and thereafter. This tendency is opposed to the concept of "productivity convergence" associated with the catch-up process of the developing countries, as indicated in Angus (1982). By subsector, the trend of TFP growth was similar between the two economies. Thus, the pattern of TFP growth for each economy was similar, but not identical. Within each economy, an internationally competitive industry did not always show a high

TFP performance. Taking the metal industry for example, the industry in Korea showed an excellent performance both in value-added growth and TFP growth; on the other hand in Taiwan, the value-added growth increased rapidly, unlike the TFP growth. These findings reflect the fact that in Korea, Pohang Iron & Steel Co. successfully achieved a scale merit while similar achievements were not recorded in Taiwan. Also, the electronics industry of Taiwan recorded both a high TFP growth and value-added growth while the TFP accounted only for a small portion of the value-added growth in the Korean industry. This finding reflects the basic characteristics of the industry in each economy. In Taiwan, computer and related industries, characterized by their lower capital intensity but higher technology intensity, recorded significant achievements, whereas in Korea, the electronics industry was mainly represented by domestic electrical appliances. Since a high capital intensity and extensive assembly process characterized the industry, the profits were small compared with the large capital input.

The distorted relationship between the comparative advantage and TFP contribution to the value-added growth was evident in the Korean electronics industry and the Taiwanese leather industry. Although these subsectors showed a strong competitiveness, the TFP did not contribute appreciably to the value-added growth. In both cases, within the whole sample period, these subsectors experienced hardships and could not achieve quick adjustment of excess capacity and employment, leading to a stagnation of production.

III. CHANGES IN TFP AND INDUSTRIALIZATION POLICIES IN KOREA AND TAIWAN

In this section an econometric analysis of the relationship between the TFP changes in Korea and Taiwan and variables related to their industrialization policies is presented. First, major studies on the TFP changes in the manufacturing sector of Korea and Taiwan were reviewed. In these studies, various factors were identified for testing the relationship with the TFP changes.

A. *Related Studies in the Past*

1. *Comparison between Korea and Taiwan*

Among the studies comparing the TFP changes in Korea and Taiwan, four papers are worth noting. Firstly, Kim, Yu, and Hwang (1984) compared the manufacturing TFP of Japan (1967–78), Korea (1967–79), and Taiwan (1967–79). In his study he observed that the TFP contributed most to the growth in Japan, least in Korea, and moderately in Taiwan. Secondly, Oshima (1987) reported that Taiwan achieved generally a higher TFP growth throughout the postwar period until the early 1980s compared to Korea. He attributed this advantage to the fact that Taiwan was able to continuously utilize the infrastructure built under the Japanese

occupation, while in Korea the postwar investment was weighed upon construction, which is characterized by a long gestation period, because during the Korean War a large part of the infrastructure was destroyed. Thirdly, Choe and Hyon (1991), who attempted to explain the TFP changes in both economies (1966–88 for Taiwan and 1968–88 for Korea) by the FDI stock and the introduced technology, observed that the FDI stock positively affected the TFP level in each economy. Fourthly, Kawai (1994) showed that during 1950–90 the gap in TFP levels with the United States and the growth contribution of exports positively affected the TFP in both economies, and that for Taiwan the FDI presence in total investment also exerted a beneficial effect on the TFP.

2. *Previous studies on Korea or Taiwan only*

Five papers are listed as follows. Firstly, using a translog production function and time-series data in 1961–80, Kwon (1986) decomposed the TFP growth of the Korean manufacturing sector into three parts (technology change, nonconstant returns to scale, and change in capital utilization) and showed that when the returns to scale and the capital utilization effects operated, the conventional TFP did not record a shift in cost or production function. Secondly, Kwak (1994) pointed out four variables which affected the TFP of the Korean manufacturing sector during 1970–85. Adverse effect was detected for the level of the effective rate of protection, the level and the difference in the factor intensity, the export ratio (for 1970–75 only), and the change in the level of effective rate of protection (for 1975–85 only). Positive effect was detected for the long-term change in the level of effective rate of protection. Thirdly, Hong and Kim (1996) estimated that during 1967–93 the TFP of the Korean manufacturing sector showed a positive correlation with the real output growth, the net export ratio, and R&D ratio to the total investment, and a negative correlation with the import ratio. Also they emphasized that the TFP should be calculated based on production, instead of value-added growth, to incorporate the effect of industrial linkages on productivity improvement from sector to sector. Fourthly, in his study on TFP changes in the Taiwan manufacturing sector, Li (1991) showed that during 1979–89 the male/female ratio of workers and the placement/retirement ratio positively affected the TFP level. He also referred to the productivity effect of R&D investment in the Taiwan manufacturing industries. Fifthly, Okuda (1994) estimated that during 1978–91 the TFP level of the Taiwan manufacturing sector was positively affected by the FDI presence in the total capital stock and negatively by the import penetration ratio. Also he showed that both the export ratio and the factor intensity affected the TFP, i.e., the higher the factor intensity, the higher the productivity effect of the export ratio.

B. *Adopted Model*

Based on the related studies, the author emphasized the following aspects in

specifying the model used in this study. Firstly, as the purpose of this study was to investigate the productivity effect of the industrialization policies of Korea and Taiwan, the author considered that such industrialization-related variables as factor intensification, involvement in exports, and import liberalization should be included in the equation. The causality between the variations in trade and TFP can be assumed in both ways.[8] However, since a simple causality test suggests that the TFP does not seem to affect selected trade-related variables,[9] the author assumed that trade-related industrialization measures, such as export promotion and import liberalization, exerted an effect on the TFP. Secondly, considering the argument of Kwon (1986), variables representing returns to scale and capital utilization were added to the regression equation. Besides their own merits, these variables were expected to help reduce the effect of business cycles, which otherwise were considered to disturb the TFP levels. As for the scale variable, the author adopted the

[8] For example, Urata (1994) argued that exports and productivity may be interrelated. The improved productivity due to trade / investment liberalization could increase exports, while an increase in exports could also improve the productivity through participation in competition abroad and expanded purchase of foreign technology, capital goods, and intermediate goods which was made possible by increased foreign exchange earnings. Also, an increase in exports could bring about scale merit, as it somewhat expanded the domestic production. As a consequence, he argued, a virtuous circle might take place involving both export expansion and productivity improvement. As for imports, Urata argued that import liberalization led to the increase of productivity by enabling the domestic producers to buy more efficient foreign machinery and parts. He did not mention the possibility that the change in productivity might affect imports; however, if the import barrier is supposed to be low enough, this could occur.

[9] The following is a table for a causality test between TFP growth and trade-related variables (export ratio and import penetration ratio) for the Korean and the Taiwanese manufacturing industries. Causality from TFP to the trade-related variables was not detected clearly.

Korea	Causality	Order	*P* (No Causality)
TFP → export ratio	?	2	0.142
Export ratio → TFP	?	2	0.239
TFP → import penetration ratio	?	2	0.112
Import penetration ratio → TFP	?	1	0.201

Taiwan	Causality	Order	*P* (No Causality)
TFP → export ratio	?	3	0.834
Export ratio → TFP	?	3	0.072
TFP → import penetration ratio	?	1	0.564
Import penetration ratio → TFP	?	1	0.161

The test was based on Granger's, and the following equation was used to test the causality from x to y.

$$y_t = \sum_{i=1}^{k} \alpha_i y_{t-i} + \sum_{i=1}^{k} \beta_i x_{t-i} + u_i,$$

where, u is a disturbance term. When all the β's are zero, x does not cause y. Although the choice of k is somewhat arbitrary, this study relied upon Akaike information criterion (AIC). Refer to Maddala (1988, pp. 329–30).

scale of a sector measured by its real total production, instead of the scale of a firm.[10] This is because one of the major policy targets of industrialization was to develop new industries, and it was necessary to evaluate the productivity impact of the new industries. Against this background, the author analyzed the changes in the TFP of the manufacturing industries of Korea and Taiwan, using the equation (2) specified below.

$$\Delta \ln TFP_{t,j} = F(\Delta \ln KL_{t,j},\ \Delta \ln EXPROD_{t,j},\ \Delta \ln PENE_{t,j},\ \Delta \ln UTIL_{t,j},\ \Delta \ln PROD_{t,j}), \quad (2)$$

where, Δ indicates that each variable covers a one- to five-year difference, subscript t denotes time, and subscript j indicates the subsectors. The time span of differentiation was fixed at one year for the dependent variable of *TFP*. For the independent variables, the time span was selected so as to maximize the adjusted coefficient of determination (R^2). *TFP* is represented by an index. *KL* represents the factor intensity of a subsector, defined as the amount of capital equipment per worker (based on 1990 prices for Korea and 1986 prices for Taiwan). This variable was assumed to enable to detect the effect of capital intensification associated with the industrialization in the two economies. *EXPROD* is the export ratio defined as the ratio of exports to total production (nominal figures for both). This variable was included in the equation to test the relationship between the *TFP* and the export expansion of a subsector. *PENE* is the import penetration ratio, defined as imports / (production + imports – exports). This variable was added to examine the productivity impact of import liberalization. All the components of the import penetration variable are nominal. *UTIL* represents the capital utilization rate, so as to control a possible productivity effect of capital utilization that could affect the production costs. For Korea, the base year was 1990 (= 100), and for the period prior to 1985, 1980-based series were adjusted and connected to the 1990-based series. For Taiwan, this variable was not included in the equation because appropriate data series were not available. *PROD* is the total real production of a subsector (based on 1990 prices for Korea and 1991 prices for Taiwan). This variable was assumed to indicate the effect of a subsector's expansion.

The estimation of the above equation was performed for the pool of the observations across the subsectors of each economy. The author's preliminary estimation for each subsector was not successful, with most of the coefficients being insignificant. To avoid the accumulation of insignificant estimates, regression on the pooled observation was used instead. In this case, we should note that each variable equally affects the respective subsectors.

[10] Production per firm is another indicator of scale. However, consistent time series of the variable could not be collected because several changes in industry classification in both economies did not enable to determine how many firms belonged to each subsector every year.

TABLE III

RESULTS OF REGRESSION ANALYSIS

A. Korea (1)

Variable	Constant	*KL2*	*EXPROD*1	*PENE*1	*PROD*2	*UTIL*1	Adjusted R^2	Samples
Coefficient	0.051608	−0.08491	−0.08018	−0.03961	0.012772	0.140062	0.171258	154
t-statistic	3.46	−1.48	−2.81	−1.16	0.30	1.92		

B. Korea (2)

Variable	Constant	*KL2*	*EXPROD*1	*PENE*1	*PROD*1	Adjusted R^2	Samples
Coefficient	0.05696	−0.10398	−0.09183	−0.04225	0.019756	0.155732	154
t-statistic	3.96	−1.81	−3.26	−1.22	0.24		

C. Taiwan

Variable	Constant	*KL5*	*EXPROD*3	*PENE5*	*PROD*1	Adjusted R^2	Samples
Coefficient	−0.02505	0.034209	−0.02045	0.023707	0.493445	0.414028	110
t-statistic	−2.47	1.94	−1.12	3.37	8.72		

Sources: TFP = for Korea: author's calculation based on Hong and Kim (1996) and Pyo et al. (1993); for Taiwan: ROC, DGBAS (1994). Capital and labor = for Korea: Hong and Kim (1996); for Taiwan, ROC, DGBAS (1994). Exports and imports = trade data retrieval system (AIDXT) of the Institute of Developing Economies. Nominal production = for Korea: ROK, National Statistical Office (various issues); for Taiwan: ROC, Department of Statistics (various issues). Real production = for Korea: author's calculation based on Hong and Kim (1996); for Taiwan: ROC, Department of Statistics (various issues). Capital utilization = for Korea: ROK, National Statistical Office (various issues).

Note: The model used in this analysis is as follows. $\Delta\ln TFP_{t,j} = F(\Delta\ln KL_{t,j}, \Delta\ln EXPROD_{t,j}, \Delta\ln PENE_{t,j}, \Delta\ln PROD_{t,j}, \Delta\ln UTIL_{t,j})$, where *TFP* = TFP index, *KL* = capital intensity, *EXPROD* = export ratio to total production (nominal), *PENE* = import penetration ratio (imports / [production + imports − exports]), *PROD* = real production, and *UTIL* = capital utilization ratio. Δ denotes one- to five-year difference. The number attached to each variable stands for the duration of the period to take difference. Sample period covers 1978–93 for Korea, 1978–92 for Taiwan.

C. *Estimation Results of the Model*

Table III displays the estimation results of the regression model. The results were very different between the two economies.

For Korea, two equations were estimated: one contained all five variables and the other all except the capital utilization for the comparison with Taiwan. It appears that for both equations, the sign and significance of each estimated coefficient were generally consistent. The adopted time span for the independent variables

was one to two years, suggesting that the TFP tended to respond to short-term variation of the independent variables. Among the estimated coefficients, the export ratio was most significant, with a strong negative effect on TFP. A detailed examination of the observations revealed that two factors could possibly lead to these results. One included the role of "bleeding exports" around the year 1980, where a rise in the export ratio did not result in TFP growth. The other corresponded to the conditions after the "three lows," when the TFP grew regardless of the variations in the export ratio.

Besides, the factor intensity was estimated to exert a negative effect, reflecting the tendency of the Korean firms to proceed to hasty investment within a short period of time, and thereafter to experience an excess capacity. It was estimated that the import penetration also affected negatively the TFP, although the significance was only marginal. The analysis of the data revealed that in the 1984–91 period around the "three lows," the TFP grew in spite of the rising import penetration, while for the years 1991–93, after the "three lows," the TFP continuously grew, but with less import penetration. The capital utilization rate was marginally significant, with a positive effect. It has been confirmed that capital utilization enables to control, at least partly, the disturbance of TFP due to business cycles. Production growth gave disappointing results as it was not related to the TFP changes, suggesting that the Korean manufacturing sector did not fully benefit from the scale merit, at least in terms of productivity.

For Taiwan, the selected time span for each independent variable was generally longer than for Korea. Except for the increase of real production, long-term variation of the independent variables exerted a stronger impact on TFP, as a difference of three to five years in the independent variables maximized the efficiency of the regression equation. Also, the efficiency of the estimation itself, measured by the adjusted coefficient of determination, was even superior to the Korean case with more samples.

The estimation showed a different picture in comparison with Korea. The import penetration and the capital intensity exerted a positive impact on the TFP, and the statistical significance of the former was very high. Analysis of the data set revealed that the import penetration was rather strongly correlated with the TFP in the subsectors of fiber and wood products. In the fiber industry, the import penetration ratio rose rather steeply after 1989, accompanied by the rising TFP. In the wood product industry, for the same period, the TFP once decreased but recovered afterwards. As for the capital intensity, the following two factors led to the estimation results: in the subsectors of fiber and leather, the values of the variable increased along with the TFP; while in the clothes industry, the opposite trend was observed. It is interesting to note that all these changes occurred in import-competing sectors. In the electronics and machinery sectors, Taiwan's leading industries, the productivity effect of the import penetration and the capital intensity was not

evident, with rising import penetration and stagnant TFP growth, or stagnant capital intensity and rising TFP.

The relationship between the export ratio and TFP was estimated to be negative, but only marginally. As far as the data set showed, only few observations indicated that the TFP and the export ratio grew at the same time. The estimation results may have been affected by more frequent cases in which TFP growth occurred in spite of the decrease in the export ratio (in food, electronics, metals, etc.). Finally, the regression results showed that the expansion of real production had a strong positive impact on the TFP growth. These findings suggest that the Taiwan manufacturing industry displayed a scale merit in the sample period. Also, since a difference of one year in the variable maximized the efficiency of the estimation, it appears that the inclusion of the variation of real production enabled to eliminate annual fluctuations of TFP growth.

D. *TFP Growth Structure and Industrialization in Korea and Taiwan*

The difference in the impact of capital intensity, negative in Korea but positive in Taiwan, may reflect the difference in the investment behavior in the two economies. The "investment competition" frequently observed among Korean firms may correspond to a variation in the market share competition, since the increase in equipment may raise the market share in the future. However, usually, the investing firms can benefit from the scale merit from additional investment only in the long run. As the history of the Korean manufacturing sector shows, investment competition often caused excess capacity, which hindered TFP growth. In Taiwan, it was estimated that the rise in the capital intensity for the past five years was linked to the TFP growth which may be attributed to the effort of the Taiwan manufacturers to fully utilize their invested equipment. For that purpose, capital-stretching, through the extension of operation hours, introduction of new technology, improvement of intermediary inputs, etc., was assumed to play an important part. In relation to the industrialization in both economies, Korea implemented the investment adjustment scheme in the early 1980s, while Taiwan enacted the technology enhancement policy in the same period. Taiwan's policies that aimed at avoiding or at least not promoting capital intensification may be relevant, considering the catch-up process of the late-coming developing economies.

As for the export ratio, the results were not consistent with the assumption that exports acted as an engine for economic growth in the NIEs. For Korea, the existence of "bleeding exports" around 1980 implied that the involvement of a sector in exports did not necessarily contribute to productivity growth, for at least some years in the sample period. Also in Taiwan, the export ratio and TFP grew at the same time in only a few instances. However, for both economies, it is worth noting that the TFP generally grew throughout the "three lows" period although the export ratio remained stagnant or even declined. Until the 1970s exportation of products

was relevant considering the fact that the domestic markets were small and the prices were competitive against the developed countries. However, after the 1980s, especially during the "three lows" period, it became more difficult for the two economies to export, especially to the developed countries, while the expansion of the domestic economies as a result of the "three lows" boom enabled the consumers of the economies to purchase the larger amount of products. The estimation period of this analysis corresponds to the end of the phase of export promotion in the two economies. The estimation results generally confirmed the relevance of the policies aimed at relaxing export promotion in the sample period.

Concerning the relationship between the change in the import penetration rate and the TFP in Taiwan, a significant productivity impact of the import penetration, which was estimated to be positive, should be pointed out. Especially the positive impact in the import-competing sectors was conspicuous, presumably due to the low capital intensity of the Taiwan manufacturing industries. Abe and Kawakami (1997) also emphasize in their paper in this volume the low capital intensity in the Taiwanese manufacturing firms. The low capital intensity may help the import-competing sectors to react rapidly to the import pressure. Also we should note that when Taiwanese firms encountered difficulties in the domestic market, they did not hesitate to invest abroad to shift their production site. It appears that Taiwan's import liberalization in the 1980s proceeded without major side effects, while in Korea, it was not easy to evaluate the effect of import liberalization at least as of 1993. Nevertheless, it is possible to assume that with radical liberalization some sectors experienced hardships.

The growth of the real output was included in the regression equation to examine the scale merit. The estimated impact differed in the two economies: it was not significant for Korea, but highly significant for Taiwan. The data set for the estimation consisted of a mixture of observations for the adjustment period of 1981–86 and the "three lows" period of 1986–89 when enthusiasm for investment dominated the Korean economy. Since such a mixture may hamper the identification of the scale merit, inconclusive results may not imply that there was no scale merit throughout the sample period. As Taiwan did not show substantial fluctuations in the output growth unlike Korea during the sample period, straightforward results were obtained. Also, based on the behavior of the Taiwan manufacturers, it seems that they did not seek to increase the output at the expense of productivity; instead they preferred to change their business or introduce new technology to further improve the productivity. For Taiwan, the variable also acted as a noise filter of yearly TFP growth fluctuations.

Finally, the capital utilization rate in Korea may account for the TFP changes in the manufacturing industries. Theoretically, it is more relevant to measure the factor input in terms of actual utilization instead of endowment in calculating the TFP index. The results confirmed this assumption.

IV. SUMMARY AND CONCLUSION

In Section I the industrialization policies of Korea and Taiwan in the postwar period were reviewed. Both economies started from export promotion, went through the stage of heavy and chemical industrialization, and eventually relaxed the export promotion and proceeded to import liberalization. In the process, Taiwan somewhat preceded Korea. The government intervention in the manufacturing sector was limited in Taiwan and was relatively intense only in the confined zone of public enterprises. On the other hand in Korea, the intervention was rather strong and widespread. As for FDI, Taiwan created a favorable environment unlike Korea, except for selected strategic industries.

In this paper the TFP of the manufacturing sector was selected as an index to compare the growth structure of Korea and Taiwan. Section II listed the TFP indices of the manufacturing sector of the two economies. Through the analysis of descriptive statistics on TFP, the inefficiency in factor input of the Korean manufacturing sector was revealed, especially for the period prior to 1986. In other words, the growth of the manufacturing sector in Korea could be explained mostly by the increase in factor inputs, which corresponds to Krugman's concept (1994) of factor-mobilizing growth.[11] Also the results corresponded to the observations of Kim, Yu, and Hwang (1984) for the period up to the 1970s that the estimated TFP growth rate decreased in the order of Japan, Taiwan, and Korea. The other interesting finding was that in the "three lows" period, after 1986, the TFP tended to contribute more to the value-added growth in both economies. This finding is in sharp contrast to the concept of productivity convergence associated with the catch-up process of developing countries. At the subsector level, the TFP tended to grow more slowly in natural resource–intensive or import-competing industries, and to grow faster in technology-intensive or internationally competitive industries. This tendency was observed in the two economies. However, detailed conditions of the TFP growth differed. For example, the TFP contribution to the value-added growth varied in the subsectors of metals and electronics, and the changes in TFP growth were generally more pronounced in Korea. Also, during the "three lows" period, the TFP contribution in Korea increased remarkably.

Section III analyzed the structure of TFP growth in both economies using an econometric model. The results revealed a contrast between the two economies. The import penetration was estimated to exert a distinctly positive impact on pro-

[11] However, note also that Kwon (1986) concluded that in Korea (1972–78) the scale effect accounted for 61.5 per cent of the TFP growth. Therefore, it may be premature to conclude that the increase in factor inputs is the main engine for the TFP growth. Thus, different methods could bring about different conclusions, an issue which is left for future research.

ductivity for Taiwan, but no significant impact for Korea. Due to the low capital intensity, Taiwan's import-competing sectors could successfully adopt rapid countermeasures against the import pressure, by moving abroad or closing out marginal firms. For the export ratio, positive productivity effect, as pointed out in World Bank (1993), was not detected. The estimation even suggested the presence of a weak but negative productivity effect of the export ratio for Korea. A close examination of the data set revealed that Korea could not avoid resorting to "bleeding exports" in the recession time around 1980, and that during the "three lows" period the TFP tended to rise regardless of the export ratio. This finding reflects the fact that the exports to the developed economies became difficult and the domestic markets expanded as a result of a boom. The capital intensity tended to hinder productivity growth in Korea, while for Taiwan the positive impact on TFP suggested that the manufacturers fully utilized their equipment. This attitude is related to the Korean firms' inclination to investment competition and the efforts of the Taiwan import-competing sectors to adapt to the adverse conditions. The growth rate of real output was included in the regression to examine the scale merit. For Korea, the data mixture of the adjustment period and the "three lows" period may have led to insignificant results. For Taiwan, it was confirmed that the variable had a positive effect on TFP. Indeed, the Taiwan private sector did not expand production without considering the need for maintaining the productivity.

Throughout the sample period, the impression of the author is that Taiwan acted rationally compared with Korea. The author considers that the difference reflects their response to the international environment by which they were equally influenced.

In Taiwan, small-capital firms operate flexibly and efficiently. They acquire equipment or increase production to improve productivity. When they face some difficulty, such as import competition, they tend to make a quick decision to move abroad or change their business. The stable growth contribution of the TFP reinforces the flexibility of factor input in Taiwan manufacturing. Also, the absence of a significant relationship between the TFP and exports implies that the marginal profits from domestic sales and exportation were balanced.

On the other hand in Korea, the manufacturers tended to prefer "gigantic" operations. In the recession of 1980, they even resorted to "bleeding exports," which did not contribute to productivity improvement subsequently. The intensification of capital overlapped investment competition, which very often resulted in excess capacity and adversely affected productivity. Although the capital utilization rate was found to be a potential explanatory factor for the TFP changes, the fitness of the regression was not good. This fact may imply that factor input was not as well fine-tuned as in the case of Taiwan.

Since the sample period of this analysis corresponded to the period after the late 1970s, the productivity effect of the industrialization policies of the two economies

was analyzed in their terminal phase. Based on the results on the productivity effect, the policies enacted were generally relevant, since the two economies relaxed export promotion and factor intensification policies in the turning point of their industrialization.

Other factors affecting productivity, such as introduction of technology, R&D investment, education, etc., are as important as the variables discussed in this analysis. However, these were not examined to secure data consistency and due to the limitation in data availability, and they will be analyzed in another report.

REFERENCES

Abe, Makoto, and Momoko Kawakami. 1997. "A Distributive Comparison of Enterprise Size in Korea and Taiwan." *Developing Economies* 35, no. 4: 382–400.

Angus, Maddison. 1982. *Phases of Capitalist Development.* Oxford: Oxford University Press.

China, Republic of (ROC), Executive Yuan, Directorate-General of Budget, Accounting and Statistics (DGBAS). 1994. *The Trends in Multifactor Productivity: Taiwan Area, Republic of China.* Taipei: Directorate-General of Budget, Accounting and Statistics.

China, Republic of (ROC), Ministry of Economic Affairs, Department of Statistics. Various issues. *Industrial Production Statistics Monthly, Taiwan Area, The Republic of China.* Taipei: Department of Statistics, Ministry of Economic Affairs.

Choe, In-bom, and Hyon Jong-taek. 1991. *Oegugin chigjop tuja-ui saengsansong hyogwa bunsok: Hanguk-gwa Taeman-ui jejoob-ul jungsim-uro* [Analysis of the productivity impact of foreign direct investment: Focusing on the manufacturing sectors in Korea and Taiwan]. Seoul: Korea Institute for International Economics and Policy.

Denison, Edward F. 1962. *The Sources of Economic Growth in the United States and the Alternatives before Us.* New York: Committee for Economic Development.

Hong, Song-dok, and Kim Jong-ho. 1996. *Jejoup chong yoso saengsansong-ui janggijog byonhwa, 1967–93* [Long-term changes in manufacturing total factor productivity, 1967–93]. Seoul: Korea Development Institute.

Hong, Taeg-gi. 1987. *Taeman-ui tuja jangryo jedo-wa oegugin tuja jinchul hwanggyong* [Investment promotion schemes in Taiwan and environment for foreign direct investment]. Seoul: Korea Institute for Economics and Technology.

Ishizaki, Nao. 1996. "Kankoku no jūkagaku kōgyōka seisaku" [Heavy and chemical industrialization policy in Korea]. In *Kankoku, Taiwan no hatten mekanizumu* [Development mechanisms in Korea and Taiwan], ed. Tamio Hattori and Yukihito Satō. Tokyo: Institute of Developing Economies.

Kawai, Hiroki. 1994. "International Comparative Analysis of Economic Growth: Trade Liberalization and Productivity." *Developing Economies* 32, no. 4: 373–97.

Kendrick, John W. 1961. *Productivity Trends in the United States.* Princeton, N.J.: Princeton University Press.

Kim, Jog-gyo; Yu Ji-song; and Hwang Gyu-ho. 1984. *Hanguk Taeman Ilbon-ui jejoob saengsansong bunsok* [Productivity analysis of the manufacturing sectors in Korea, Taiwan, and Japan]. Seoul: Hanyang University.

Korea, Republic of (ROK), Ministry of Finance, and Korea Development Bank. 1993. *Hangug oeja doip 30-nyon sa* [Thirty-year history of Korea's foreign capital introduc-

tion]. Seoul: Ministry of Finance, and Korea Development Bank.
Korea, Republic of (ROK), National Statistical Office. Various issues. *Annual Report on Monthly Industrial Production Statistics*. Seoul: National Statistical Office.
Krugman, Paul. 1994. "The Myth of Asia's Miracle." *Foreign Affairs* 73, no. 6: 63–79.
Kwak, Hyuntai. 1994. "Changing Trade Policy and Its Impact on TFP in the Republic of Korea." *Developing Economies* 32, no. 4: 398–422.
Kwon, Jene K. 1986. "Capital Utilization, Economies of Scale and Technical Change in the Growth of Total Factor Productivity: An Explanation of South Korean Manufacturing Growth." *Journal of Development Economics* 24, no. 1: 75–89.
Li, Wen-fu. 1991. "Taiwan zhizaoye zongyaosu shengchanli jishu jiubu yu jishu xiaolu" [Total factor productivity of Taiwan's manufacturing sector: Technological improvement and efficiency]. Parts 1 and 2. *Ziyou Zhongguo zhi gongye*, June, 21–34; July, 29–52.
Maddala, G. S. 1988. *Introduction to Econometrics*. New York: Macmillan.
Ohyane, Satoshi. 1992. "Nichibei bōeki masatsu to kanbei bōeki masatsu: Masatsu no hakyū ni kansuru seisaku katei bunseki" [Japan-U.S. trade friction and Korea-U.S. trade friction: An analysis on political process of the spillover of friction]. *Ajia kenkyū* 38, no. 3: 33–72.
Okuda, Satoru. 1994. "Taiwan's Trade and FDI Policies and Their Effect on Productivity Growth." *Developing Economies* 32, no. 4: 423–43.
Oshima, Harry T. 1987. *Economic Growth in Monsoon Asia: A Comparative Survey*. Tokyo: University of Tokyo Press.
Pyo, Hak-kil; Kong Byong-ho; Kwon Ho-young; and Kim Un-ja. 1993. *Hangug-ui sanobbyol songjang yoin bunsog mich saengsansong chugye (1970–1990)* [Sources of industrial growth and productivity estimates in Korea (1970–1990)]. Seoul: Korea Economic Research Institute.
Satō, Yukihito, ed. 1994. "Minkan keizai kyōryoku chōsa kenkyū hōkokusho, dai-3 bunsatsu, Taiwan" [A research report on private sector economic cooperation, part 3, Taiwan]. Tokyo: Institute of Developing Economies.
Siew, Vincent C. 1992. "Woguo maoyi ziyouhua de huigu ji zhanwang" [Retrospect and prospect for Taiwan's trade liberalization]. *Ziyou Zhongguo zhi gongye*, October, 1–8.
Urata, Shujiro. 1994. "Trade Liberalization and Productivity Growth in Asia: Introduction and Major Findings." *Developing Economies* 32, no. 4: 363–72.
World Bank. 1993. *The East Asian Miracle: Economic Growth and Public Policy*. New York: Oxford University Press for the World Bank.

APPENDIX TABLE I

SECTOR CLASSIFICATION: KOREA

Sector Classification in TFP Statistics	Adopted Classification
Manufacturing	Manufacturing
Food Beverage Tobacco	Food
Fiber Clothes Leather and fur products Footware (nonrubber and nonplastic)	Fiber and clothes
Wood and cork products Furniture (nonmetallic) Paper and paper products Printing and publishing	Paper and wood products
Industrial chemicals Other chemical products Rubber products Plastic products	Chemicals
Oil refinery Other petroleum and coal products	Oil refinery
Pottery Glass and glass products Other nonmetals	Nonmetals
Iron and steel Nonferrous metal Metal products	Metals
General machinery Precision equipment	Machinery
Electronics	Electronics
Transport equipment	Transport equipment
Other manufacturing	Other manufacturing

APPENDIX TABLE II

SECTOR CLASSIFICATION: TAIWAN

Sector Classification in TFP Statistics	Adopted Classification
Manufacturing	Manufacturing
Food and kindred products Beverage and tobacco manufactures	Food
Textile mill products	Fiber
Apparel and other textile products	Clothes
Leather, fur, and related products	Leather
Wood and bamboo products, and nonmetallic furniture	Wood products
Paper and paper products; printing and publishing	Paper
Industrial chemicals, chemical and plastic products Petroleum and coal products Rubber products	Chemicals
Nonmetallic mineral products	Nonmetals
Primary metal industries Fabricated metal products	Metals
Machinery except electrical equipment Transportation equipment Precision equipment	Machinery
Electrical and electronic equipment	Electronics
Miscellaneous manufacturing industries	